
COVER SHEET

Responsible Agency: United States Department of Energy

Cooperating Agency: Tennessee Valley Authority

Title: Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor

Contact: For additional information on this Final Environmental Impact Statement, write or call:

Jay Rose
Office of Defense Programs
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
Attention: CLWR EIS
Telephone: (202) 586-5484

For copies of the CLWR Final EIS call: 1-800-332-0801

For general information on the DOE National Environmental Policy Act (NEPA) process, write or call:

Carol M. Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
Telephone: (202) 586-4600, or leave a message at: (800) 472-2756

Abstract: The U.S. Department of Energy (DOE) is responsible for providing the nation with nuclear weapons and ensuring that these weapons remain safe and reliable. Tritium, a radioactive isotope of hydrogen, is an essential component of every weapon in the current and projected U.S. nuclear weapons stockpile. Unlike other materials utilized in nuclear weapons, tritium decays at a rate of 5.5 percent per year. Accordingly, as long as the nation relies on a nuclear deterrent, the tritium in each nuclear weapon must be replenished periodically. Currently the U.S. nuclear weapons complex does not have the capability to produce the amounts of tritium that will be required to continue supporting the nation's stockpile. The *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (Final Programmatic EIS), DOE/EIS-0161, issued in October 1995, evaluated the alternatives for the siting, construction, and operation of tritium supply and recycling facilities at five DOE sites for four different production technologies. This Programmatic EIS also evaluated the impacts of using a commercial light water reactor (CLWR) without specifying a reactor location. In the Record of Decision for the Final Programmatic EIS (60 FR 63878), issued December 12, 1995, DOE decided to pursue a dual-track approach on the two most promising tritium supply alternatives: (1) to initiate purchase of an existing commercial reactor (operating or partially complete) or reactor irradiation services; and (2) to design, build, and test critical components of an accelerator system for tritium production. At that time, DOE announced that the final decision would be made by the Secretary of Energy at the end of 1998.

On December 22, 1998, Secretary of Energy Bill Richardson announced that the CLWR would be DOE's primary option for tritium production, and the proposed linear accelerator at the Savannah River Site would be the back-up option. The Secretary designated the Tennessee Valley Authority's (TVA) Watts Bar and Sequoyah Nuclear Plants as the Preferred Alternative for CLWR tritium production. The Secretary's announcement that the CLWR would be the primary tritium supply technology reaffirms the 1995 Record of Decision for the Final Programmatic EIS to construct and operate a new tritium extraction capability at the Savannah River Site.

This *Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (CLWR EIS) evaluates the environmental impacts associated with producing tritium at one or more of the following five CLWRs: (1) Watts Bar Nuclear Plant Unit 1 (Spring City, Tennessee); (2) Sequoyah Nuclear Plant Unit 1 (Soddy Daisy, Tennessee); (3) Sequoyah Nuclear Plant Unit 2 (Soddy Daisy, Tennessee); (4) Bellefonte Nuclear Plant Unit 1 (Hollywood, Alabama); and (5) Bellefonte Nuclear Plant Unit 2 (Hollywood, Alabama). Specifically, this EIS analyzes the potential environmental impacts associated with fabricating tritium-producing burnable absorber rods (TPBARs); transporting nonirradiated TPBARs from the fabrication facility to the reactor sites; irradiating TPBARs in the reactors; and transporting irradiated TPBARs from the reactors to the proposed tritium extraction facility at the Savannah River Site in South Carolina.

The public comment period on the CLWR Draft EIS extended from August 28 to October 27, 1998. During the comment period, public hearings were held in North Augusta, South Carolina; Rainsville, Alabama; and Evensville, Tennessee. An additional public meeting was held in Evensville, Tennessee, on December 14, 1998. The CLWR Draft EIS was made available through mailings and requests to DOE's CLWR Office and at DOE's Public Reading Rooms. In preparing the CLWR Final EIS, DOE considered comments received via mail, fax, submission at public hearings, recorded telephone messages, and the Internet. In addition, comments and concerns identified during discussions at the public hearings were recorded by a court reporter and were transcribed for consideration by DOE.

The CLWR Final EIS contains revisions and new information in response to the comments on the CLWR Draft EIS and technical details disclosed since the Draft EIS was issued. These revisions and new information are indicated by a double underline for minor word changes or by a sidebar in the margin for sentence or larger changes. Volume 2 (Comment Response Document) of the CLWR Final EIS contains the comments received during the public review of the CLWR Draft EIS and DOE's responses to these comments.

No sooner than 30 days after the notice of filing this EIS with the U.S. Environmental Protection Agency, DOE expects to issue a Record of Decision.

PREFACE

The *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (Final Programmatic EIS) (DOE/EIS-0161), which was completed in October 1995, assessed the potential environmental impacts of technology and siting alternatives for the production of tritium for national security purposes. On December 5, 1995, DOE issued a Record of Decision for the Final Programmatic EIS that selected the two most promising alternative technologies for tritium production and established a dual-track strategy that would, within 3 years, select one of those technologies to become the primary tritium supply technology. The other technology, if feasible, would be developed as a backup tritium source. Under the dual-track strategy, DOE would: (1) initiate the purchase of an existing commercial reactor (operating or partially complete) or irradiation services with an option to purchase the reactor for conversion to a defense facility; and (2) design, build, and test critical components of an accelerator system for tritium production. Under the Final Programmatic EIS Record of Decision, any new facilities that might be required, i.e., an accelerator and/or a tritium extraction facility to support the commercial reactor alternative, would be constructed at DOE's Savannah River Site in South Carolina.

The Final Programmatic EIS described a two-phase strategy for compliance with the National Environmental Policy Act (NEPA). The first phase included completion of the Final Programmatic EIS and subsequent Record of Decision. The second phase included the preparation of site-specific NEPA documents tiered from the Final Programmatic EIS. These EISs address the environmental impacts of specific project proposals. As a result of the Final Programmatic EIS and the Record of Decision, DOE determined to prepare three site-specific EISs: the *Environmental Impact Statement, Accelerator Production of Tritium at the Savannah River Site* (APT) (DOE/EIS-0270), the *Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (CLWR) (DOE/EIS-0288), and the *Environment Impact Statement, Construction and Operation of a Tritium Extraction Facility at Savannah River Site* (TEF) (DOE/EIS-0271). Each of these EISs presents an analysis of alternatives which do not affect the alternatives in the other EISs, with one exception. This exception is one alternative in the TEF EIS which would require the use of space in the APT. For this alternative to be viable, the APT would have to be selected as the primary source of tritium.

On December 22, 1998, Secretary of Energy Bill Richardson announced that commercial light water reactors (CLWR) will be the primary tritium supply technology. The Secretary designated the Watts Bar Unit 1 reactor near Spring City, Tennessee, and the Sequoyah Units 1 and 2 reactors near Soddy-Daisy, Tennessee, as the preferred commercial light water reactors for tritium production. These reactors are operated by the Tennessee Valley Authority (TVA), an independent government agency. The Secretary designated the APT as the "backup" technology for tritium supply. As a backup, DOE will continue with developmental activities and preliminary design, but will not construct the accelerator. Finally, selection of the CLWR reaffirms the December 1995 Final Programmatic EIS Record of Decision to construct and operate a new tritium extraction capability at the Savannah River Site.

DOE has completed the final EISs for the APT, CLWR, and TEF. No sooner than 30 days after publication in the *Federal Register* of the Environmental Protection Agency's Notice of Availability of the final EISs for APT, CLWR, and TEF, DOE intends to issue a consolidated Record of Decision to: (1) formalize the programmatic announcement made on December 22, 1998; and (2) announce project-specific decisions for the three EISs. These decisions will include, for the selected CLWR technology, the selection of specific CLWRs to be used for tritium supply and the location of a new tritium extraction capability at the Savannah River Site. For the backup APT technology, technical and siting decisions consistent with its backup role will be made.

TABLE OF CONTENTS

VOLUME 1

Page

| | |
|----------------------------------|-------|
| Cover Sheet | iii |
| Preface | v |
| Table of Contents | ix |
| List of Figures | xvii |
| List of Tables | xix |
| Acronyms and Abbreviations | xxvii |

| | |
|--|------------|
| 1. INTRODUCTION | 1-1 |
| 1.1 Overview | 1-1 |
| 1.1.1 General | 1-1 |
| 1.1.2 Proposed Action and Scope | 1-1 |
| 1.1.3 Development of the CLWR EIS | 1-2 |
| 1.1.4 The CLWR Procurement Process | 1-2 |
| 1.2 Commercial Light Water Reactor Facilities Analyzed in this CLWR EIS | 1-4 |
| 1.3 Background | 1-6 |
| 1.3.1 Defense Programs Mission | 1-6 |
| 1.3.2 Nuclear Weapons | 1-6 |
| 1.3.3 Brief History of the Production of Tritium | 1-9 |
| 1.3.4 Production of Tritium in a CLWR | 1-9 |
| 1.3.5 Nonproliferation | 1-9 |
| 1.3.6 Background on the Tennessee Valley Authority | 1-11 |
| 1.4 NEPA Strategy | 1-12 |
| 1.5 Other Relevant NEPA Reviews | 1-12 |
| 1.5.1 Completed NEPA Actions | 1-12 |
| 1.5.1.1 Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling | 1-12 |
| 1.5.1.2 Lead Test Assembly Environmental Assessment | 1-13 |
| 1.5.1.3 EISs for the Operation of Watts Bar 1 and Sequoyah 1 and 2 and for Construction of Bellefonte 1 and 2 | 1-13 |
| 1.5.2 Ongoing NEPA Actions | 1-13 |
| 1.5.2.1 Environmental Impact Statement, Accelerator Production of Tritium at the Savannah River Site | 1-13 |
| 1.5.2.2 Environmental Impact Statement, Construction and Operation of a Tritium Extraction Facility at the Savannah River Site | 1-14 |
| 1.5.2.3 Environmental Assessment for the Tritium Facility Modernization and Consolidation Project at the Savannah River Site | 1-14 |
| 1.5.2.4 Final Environmental Impact Statement for the Bellefonte Conversion Project | 1-14 |
| 1.6 Organization of this EIS | 1-14 |
| 1.7 Public Scoping Process | 1-15 |
| 1.8 Public Comment Period | 1-16 |
| 1.9 Changes from the Draft Environmental Impact Statement | 1-20 |
| 2. PURPOSE AND NEED | 2-1 |

| | |
|---|----------------|
| 3. COMMERCIAL LIGHT WATER REACTOR PROGRAM ALTERNATIVES | 3-1 |
| 3.1 Production of Tritium in a Commercial Light Water Reactor | 3-1 |
| 3.1.1 Generation of Electric Power in Nuclear Power Plants | 3-1 |
| 3.1.2 Description of Tritium-Producing Burnable Absorber Rods | 3-2 |
| 3.1.3 Impacts of Tritium Production on Reactor Operations | 3-7 |
| 3.2 Development of Alternatives | 3-8 |
| 3.2.1 Planning Assumptions and Basis for Analysis | 3-8 |
| 3.2.2 Reactor Options Considered | 3-10 |
| 3.2.3 Reasonable Alternatives | 3-11 |
| 3.2.4 No Action Alternative | 3-13 |
| 3.2.5 Reactor Options | 3-13 |
| 3.2.5.1 Watts Bar Nuclear Plant Unit 1 | 3-13 |
| 3.2.5.2 Sequoyah Nuclear Plant Units 1 and 2 | 3-17 |
| 3.2.5.3 Bellefonte Nuclear Plant Units 1 and 2 | 3-20 |
| 3.2.6 Comparison of Alternatives | 3-25 |
| 3.2.6.1 No Action Alternative Impacts | 3-26 |
| 3.2.6.2 <u>Impacts Associated with Tritium Production</u> | 3-26 |
| 3.2.7 Preferred Alternative | 3-30 |
| 4. AFFECTED ENVIRONMENT | 4-1 |
| 4.1 Introduction | 4-1 |
| 4.2 Affected Environment | 4-2 |
| 4.2.1 Watts Bar Nuclear Plant Unit 1 | 4-2 |
| 4.2.1.1 Land Resources | 4-3 |
| 4.2.1.2 Noise | 4-6 |
| 4.2.1.3 Air Quality | 4-7 |
| 4.2.1.4 Water Resources | 4-10 |
| 4.2.1.5 Geology and Soils | 4-14 |
| 4.2.1.6 Ecological Resources | 4-15 |
| 4.2.1.7 Archaeological and Historic Resources | 4-19 |
| 4.2.1.8 Socioeconomics | 4-20 |
| 4.2.1.9 Public and Occupational Health and Safety | 4-24 |
| 4.2.1.10 Waste Management | 4-28 |
| 4.2.1.11 Spent Fuel Management | 4-29 |
| 4.2.2 Sequoyah Nuclear Plant Units 1 and 2 | 4-30 |
| 4.2.2.1 Land Resources | 4-31 |
| 4.2.2.2 Noise | 4-34 |
| 4.2.2.3 Air Quality | 4-34 |
| 4.2.2.4 Water Resources | 4-38 |
| 4.2.2.5 Geology and Soils | 4-41 |
| 4.2.2.6 Ecological Resources | 4-42 |
| 4.2.2.7 Archaeological and Historic Resources | 4-46 |
| 4.2.2.8 Socioeconomics | 4-47 |
| 4.2.2.9 Public and Occupational Health and Safety | 4-52 |
| 4.2.2.10 Waste Management | 4-55 |
| 4.2.2.11 Spent Fuel Management | 4-56 |
| 4.2.3 Bellefonte Nuclear Plant Units 1 and 2 | 4-57 |
| 4.2.3.1 Land Resources | 4-58 |
| 4.2.3.2 Noise | 4-61 |
| 4.2.3.3 Air Quality | 4-62 |
| 4.2.3.4 Water Resources | 4-64 |
| 4.2.3.5 Geology and Soils | 4-68 |
| 4.2.3.6 Ecological Resources | 4-68 |
| 4.2.3.7 Archaeological and Historic Resources | 4-75 |
| 4.2.3.8 Socioeconomics | 4-76 |
| 4.2.3.9 Public and Occupational Health and Safety | 4-88 |

| | | |
|-----------|---|------------|
| 4.2.3.10 | Waste Management | 4-88 |
| 4.2.3.11 | Spent Fuel Management | 4-89 |
| 5. | ENVIRONMENTAL CONSEQUENCES | 5-1 |
| 5.1 | Introduction | 5-1 |
| 5.1.1 | Methodology | 5-1 |
| 5.1.2 | Assumptions | 5-2 |
| 5.2 | Environmental Consequences | 5-3 |
| 5.2.1 | Watts Bar Nuclear Plant Unit 1 | 5-3 |
| 5.2.1.1 | Land Resources | 5-3 |
| 5.2.1.2 | Noise | 5-4 |
| 5.2.1.3 | Air Quality | 5-4 |
| 5.2.1.4 | Water Resources | 5-5 |
| 5.2.1.5 | Geology and Soils | 5-7 |
| 5.2.1.6 | Ecological Resources | 5-7 |
| 5.2.1.7 | Archaeological and Historic Resources | 5-8 |
| 5.2.1.8 | Socioeconomics | 5-8 |
| 5.2.1.9 | Public and Occupational Health and Safety | 5-9 |
| 5.2.1.9.1 | Normal Operation | 5-9 |
| 5.2.1.9.2 | Facility Accidents | 5-12 |
| 5.2.1.10 | Environmental Justice | 5-15 |
| 5.2.1.11 | Waste Management | 5-16 |
| 5.2.1.12 | Spent Fuel Management | 5-16 |
| 5.2.2 | Sequoyah Nuclear Plant Units 1 and 2 | 5-16 |
| 5.2.2.1 | Land Resources | 5-16 |
| 5.2.2.2 | Noise | 5-17 |
| 5.2.2.3 | Air Quality | 5-18 |
| 5.2.2.4 | Water Resources | 5-19 |
| 5.2.2.5 | Geology and Soils | 5-20 |
| 5.2.2.6 | Ecological Resources | 5-21 |
| 5.2.2.7 | Archaeological and Historic Resources | 5-22 |
| 5.2.2.8 | Socioeconomics | 5-22 |
| 5.2.2.9 | Public and Occupational Health and Safety | 5-23 |
| 5.2.2.9.1 | Normal Operations | 5-23 |
| 5.2.2.9.2 | Facility Accidents | 5-26 |
| 5.2.2.10 | Environmental Justice | 5-29 |
| 5.2.2.11 | Waste Management | 5-30 |
| 5.2.2.12 | Spent Fuel Management | 5-30 |
| 5.2.3 | Bellefonte Nuclear Plant Units 1 and 2 | 5-31 |
| 5.2.3.1 | Land Resources | 5-31 |
| 5.2.3.2 | Noise | 5-33 |
| 5.2.3.3 | Air Quality | 5-36 |
| 5.2.3.4 | Water Resources | 5-42 |
| 5.2.3.5 | Geology and Soils | 5-50 |
| 5.2.3.6 | Ecological Resources | 5-51 |
| 5.2.3.7 | Archaeological and Historic Resources | 5-56 |
| 5.2.3.8 | Socioeconomics | 5-57 |
| 5.2.3.8.1 | Bellefonte 1 | 5-57 |
| 5.2.3.8.2 | Bellefonte 1 and 2 | 5-63 |
| 5.2.3.9 | Public and Occupational Health and Safety | 5-69 |
| 5.2.3.9.1 | Normal Operation | 5-69 |
| 5.2.3.9.2 | Facility Accidents | 5-76 |
| 5.2.3.10 | Environmental Justice | 5-82 |
| 5.2.3.11 | Waste Management | 5-83 |
| 5.2.3.12 | Spent Fuel Management | 5-85 |
| 5.2.4 | Licensing Renewal | 5-85 |
| 5.2.4.1 | Background | 5-86 |

| | | |
|-----------|---|------------|
| 5.2.4.2 | Environmental Effect of Renewing the Operating License of a Nuclear Power Plant . . | 5-87 |
| 5.2.5 | Decontamination and Decommissioning | 5-90 |
| 5.2.5.1 | Background | 5-90 |
| 5.2.5.2 | Decontamination and Decommissioning Options | 5-90 |
| 5.2.5.3 | Decommissioning Activities | 5-91 |
| 5.2.5.4 | Decontamination and Decommissioning Impacts | 5-91 |
| 5.2.6 | Spent Fuel Storage | 5-93 |
| 5.2.7 | Fabrication of TPBARs and Blend-Down of Highly Enriched Uranium | 5-103 |
| 5.2.8 | Transportation of TPBARs | 5-105 |
| 5.2.9 | Sensitivity Analysis | 5-107 |
| 5.2.10 | Safeguards and Security | 5-112 |
| 5.2.11 | Programmatic No Action | 5-113 |
| 5.2.12 | CLWR Facility Accident Impact to Involved Workers | 5-117 |
| 5.2.13 | Secondary Impact of CLWR Facility Accidents | 5-118 |
| 5.3 | Cumulative Impacts | 5-118 |
| 5.3.1 | TPBAR Fabrication | 5-119 |
| 5.3.2 | TPBAR Irradiation | 5-119 |
| 5.3.3 | TPBAR Transportation | 5-123 |
| 5.3.4 | Impacts at the Tritium Extraction Facility | 5-124 |
| 5.4 | Resource Commitments | 5-128 |
| 5.4.1 | Unavoidable Adverse Environmental Impacts | 5-128 |
| 5.4.2 | Relationship Between Local Short-Term Uses of the Environment and Enhancement of Long-Term Productivity | 5-129 |
| 5.4.3 | Irreversible and Irretrievable Commitments of Resources | 5-129 |
| 5.5 | Mitigation Measures | 5-130 |
| 6. | APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS | 6-1 |
| 6.1 | Introduction and Background | 6-1 |
| 6.2 | Statutes and Regulations Requiring Licenses or Permits | 6-2 |
| 6.2.1 | Nuclear Regulatory Commission Permits and Licenses | 6-3 |
| 6.2.2 | Environmental Protection Permits | 6-3 |
| 6.3 | Other Requirements Related to Environmental Protection, Emergency Planning, and Worker Safety and Health | 6-6 |
| 6.3.1 | Environmental Protection | 6-6 |
| 6.3.2 | Emergency Planning and Response | 6-8 |
| 6.3.3 | Worker Safety and Health | 6-9 |
| 6.4 | DOE Regulations and Orders | 6-9 |
| 6.5 | Compliance History | 6-9 |
| 6.5.1 | Compliance Indicators | 6-10 |
| 6.5.1.1 | Systematic Assessments of License Performance | 6-10 |
| 6.5.1.2 | NRC Notices of Violations and Enforcement Actions | 6-10 |
| 6.5.1.3 | Performance Indicators | 6-11 |
| 6.5.2 | Watts Bar 1 | 6-11 |
| 6.5.2.1 | NRC Performance | 6-11 |
| 6.5.2.2 | Environmental, Safety & Health (Nonnuclear) Performance | 6-14 |
| 6.5.3 | Sequoyah Nuclear Plant Units 1 and 2 | 6-14 |
| 6.5.3.1 | <u>NRC</u> Performance | 6-14 |
| 6.5.3.2 | Environmental, Safety & Health (Nonnuclear) Performance | 6-17 |
| 6.5.4 | Bellefonte Nuclear Plant Units 1 and 2 | 6-18 |
| 6.5.4.1 | Performance | 6-18 |
| 6.5.4.2 | Environmental, Safety & Health (Nonnuclear) Performance | 6-18 |

| | |
|-----------------------------------|-------------|
| 7. REFERENCES | 7-1 |
| 8. LIST OF PREPARERS | 8-1 |
| 9. DISTRIBUTION LIST | 9-1 |
| 10. GLOSSARY | 10-1 |
| 11. INDEX | 11-1 |

APPENDIX A

TRITIUM PRODUCTION OPERATIONS—APPLICATION TO PRODUCTION OF TRITIUM IN COMMERCIAL LIGHT WATER REACTORS

| | |
|---|------------|
| A-1 | A-1 |
| A.1 Nuclear Fission Reactors | A-1 |
| A.1.1 Nuclear Fission | A-1 |
| A.1.2 Control of Nuclear Reactions in a Reactor | A-2 |
| A.2 Commercial Nuclear Power Plant Descriptions | A-5 |
| A.2.1 Commercial Nuclear Reactors | A-5 |
| A.2.2 Reactor Core Description | A-7 |
| A.2.3 Reactor Refueling | A-12 |
| A.2.4 Commercial Light Water Reactor Systems Important to Environmental Impacts | A-14 |
| A.2.4.1 Cooling and Auxiliary Water Systems | A-14 |
| A.2.4.2 Radioactive Waste Treatment Systems | A-15 |
| A.2.4.3 Nonradioactive Waste Systems | A-17 |
| A.3 Tritium-Producing Burnable Absorber Rods | A-17 |
| A.3.1 Nucleonics of Tritium-Producing Burnable Absorber Rods | A-17 |
| A.3.2 Physical Description of the Tritium-Producing Burnable Absorber Rod | A-19 |
| A.3.3 Handling of Tritium-Producing Burnable Absorber Rods | A-21 |
| A.4 Impact of Tritium Production on the Fuel Cycle | A-22 |
| A.5 References | A-24 |

APPENDIX B

METHODS FOR ASSESSING ENVIRONMENTAL IMPACTS—APPLICATION TO PRODUCTION OF TRITIUM IN COMMERCIAL LIGHT WATER REACTORS

| | |
|---|------------|
| B-1 | B-1 |
| B.1 Land Resources | B-2 |
| B.1.1 Land Use | B-2 |
| B.1.2 Visual Resources | B-2 |
| B.2 Air Quality and Noise | B-2 |
| B.2.1 Air Quality | B-2 |
| B.2.2 Noise | B-3 |
| B.3 Water Resources | B-3 |
| B.4 Geology and Soils | B-4 |
| B.5 Ecology | B-4 |
| B.6 Archaeological and Historic Resources | B-5 |
| B.7 Socioeconomics | B-5 |
| B.8 Public and Occupational Health and Safety | B-5 |
| B.8.1 Emergency Preparedness | B-7 |
| B.9 Waste Management | B-7 |
| B.10 Transportation | B-7 |
| B.11 Spent Fuel Management | B-7 |
| B.12 Environmental Justice | B-8 |
| B.13 Applicable Environmental Laws, Regulations, and Guidance | B-8 |
| B.14 References | B-14 |

APPENDIX C

| | |
|--|------------|
| EVALUATION OF HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS | C-1 |
| C.1 Introduction | C-1 |
| C.2 Radiological Impacts on Human Health | C-1 |
| C.2.1 Background Information | C-2 |
| C.2.1.1 Nature of Radiation and Its Effects on Humans | C-2 |
| C.2.1.2 Health Effects | C-7 |
| C.2.2 Tritium Characteristics and Biological Properties | C-10 |
| C.2.2.1 Tritium Characteristics | C-10 |
| C.2.2.2 Biological Properties of Tritium | C-10 |
| C.2.2.3 Genetic Effects of Tritium | C-12 |
| C.3 Methodology for Estimating Radiological Impacts | C-13 |
| C.3.1 GENII Computer Code | C-13 |
| C.3.2 Data and General Assumptions | C-14 |
| C.3.3 Uncertainties | C-18 |
| C.3.4 Radiological Releases to the Environment and Associated Impact | C-19 |
| C.4 Impacts of Exposures to Hazardous Chemicals on Human Health | C-23 |
| C.5 References | C-27 |

APPENDIX D

| | |
|---|------------|
| EVALUATION OF HUMAN HEALTH EFFECTS FROM FACILITY ACCIDENTS | D-1 |
| D.1 Radiological Accident Impacts on Human Health | D-1 |
| D.1.1 Accident Scenario Selection and Description | D-1 |
| D.1.1.1 Accident Scenario Selection | D-1 |
| D.1.1.2 Reactor Design-Basis Accident | D-2 |
| D.1.1.3 Nonreactor Design-Basis Accident | D-3 |
| D.1.1.4 TPBAR Handling Accident | D-4 |
| D.1.1.5 Truck Transportation Cask Handling Accident at the Reactor Site | D-5 |
| D.1.1.6 Truck Transportation Cask Handling Accident at the Tritium Extraction Facility | D-6 |
| D.1.1.7 Rail Transportation Cask Handling Accident at the Reactor Site | D-6 |
| D.1.1.8 Rail Transportation Cask Handling Accident at the Savannah River Site Rail Transfer Station | D-7 |
| D.1.1.9 Rail Transportation Cask Handling Accident at the Tritium Extraction Facility | D-8 |
| D.1.1.10 Beyond Design-Basis Accident | D-8 |
| D.1.2 Methodology for Estimating Radiological Impacts | D-16 |
| D.1.2.1 Introduction | D-16 |
| D.1.2.2 MACCS2 Computer Code | D-16 |
| D.1.2.3 Data and General Assumptions | D-18 |
| D.1.2.4 Health Effects Calculations | D-20 |
| D.1.2.5 Deterministic Calculations | D-21 |
| D.1.2.5.1 Introduction | D-21 |
| D.1.2.5.2 Large Break Loss-of-Coolant Accident | D-21 |
| D.1.2.5.3 Waste Gas Decay Tank Accident | D-24 |
| D.1.2.6 Uncertainties | D-25 |
| D.1.3 Accident Consequences and Risks | D-26 |
| D.1.3.1 Reactor Design-basis Accident | D-26 |
| D.1.3.2 Nonreactor Design-Basis Accident | D-26 |
| D.1.3.3 TPBAR Handling Accident | D-31 |
| D.1.3.4 Truck Transportation Cask Handling Accident | D-32 |
| D.1.3.5 Rail Transportation Cask Handling Accident | D-33 |
| D.1.3.6 Beyond Design-Basis Accident | D-34 |
| D.2 Hazardous Chemical Accident Impacts on Human Health | D-37 |
| D.2.1 Accident Scenario Selection and Description | D-37 |
| D.2.1.1 Accident Scenario Selection | D-37 |
| D.2.1.2 Accident Scenario Descriptions | D-38 |

| | | |
|---------|--|------|
| D.2.2 | Chemical Accident Analysis Methodology | D-39 |
| D.2.2.1 | Receptor Description | D-39 |
| D.2.2.2 | Analysis Computer Code Selection | D-40 |
| D.2.2.3 | Description of the Model | D-40 |
| D.2.2.4 | Weather Condition Assumptions | D-41 |
| D.2.3 | Human Health Impacts | D-41 |
| D.2.3.1 | Impacts to Noninvolved Workers | D-41 |
| D.2.3.2 | Offsite Impacts | D-43 |
| D.2.3.3 | Uncertainties in the Dispersion Analyses | D-43 |
| D.3 | References | D-44 |

APPENDIX E

EVALUATION OF HUMAN HEALTH EFFECTS OF OVERLAND TRANSPORTATION E-1

| | | |
|-----------|--|------|
| E.1 | Introduction | E-1 |
| E.2 | Scope of Assessment | E-1 |
| E.3 | Packaging and Representative Shipment Configurations | E-3 |
| E.3.1 | Packaging Overview | E-3 |
| E.3.2 | Regulations Applicable to Type B Casks | E-3 |
| E.3.2.1 | Cask Design Regulations | E-4 |
| E.3.2.2 | Design Certification | E-7 |
| E.3.2.3 | Transportation Regulations | E-7 |
| E.3.2.4 | Communications | E-9 |
| E.3.3 | Ground Transportation Route Selection Process | E-9 |
| E.4 | Methods for Calculating Transportation Risks | E-10 |
| E.5 | Alternatives, Parameters, and Assumptions | E-12 |
| E.5.1 | Description of Alternatives | E-12 |
| E.5.2 | Representative Routes | E-13 |
| E.5.3 | Material Inventory | E-16 |
| E.5.4 | External Dose Rates | E-18 |
| E.5.5 | Health Risk Conversion Factors | E-18 |
| E.5.6 | Accident Involvement Rates | E-18 |
| E.5.7 | Container Accident Response Characteristics and Release Fractions | E-18 |
| E.5.7.1 | Development of Conditional Probabilities | E-18 |
| E.5.7.2 | Transportation Risk Analyses Assumptions | E-21 |
| E.5.7.2.1 | Cask Response to Impact and Thermal Loads | E-21 |
| E.5.7.2.2 | TPBARs Response to Impact and Thermal Loads | E-22 |
| E.5.7.3 | Accident Matrix Category Descriptions | E-23 |
| E.5.7.3.1 | Elastomeric Seals | E-23 |
| E.5.7.3.2 | Metallic Seals | E-23 |
| E.5.7.3.3 | Accident Category Release Fractions for Tritium, Nontarget-Bearing Components, and Crud | E-24 |
| E.5.7.3.4 | Accident Category Severity Fractions | E-26 |
| E.5.8 | Nonradiological Risk (Vehicle-Related) | E-26 |
| E.6 | Risk Analysis Results | E-26 |
| E.7 | Conclusions and Long-Term Impacts of Transportation | E-32 |
| E.7.1 | Conclusions | E-32 |
| E.7.2 | Long-Term Impacts of Transportation | E-32 |
| E.8 | Uncertainty and Conservatism in Estimated Impacts | E-33 |
| E.8.1 | Uncertainties in TPBAR and Radioactive Waste Inventory and Characterization | E-34 |
| E.8.2 | Uncertainties in Containers, Shipment Capacities, and Number of Shipments | E-34 |
| E.8.3 | Uncertainties in Route Determination | E-34 |
| E.8.4 | Uncertainties in the Calculation of Radiation Doses | E-34 |
| E.9 | References | E-37 |

APPENDIX F

| | |
|--|------------|
| THE PUBLIC SCOPING PROCESS | F-1 |
| F.1 Scoping Process Description | F-1 |
| F.2 Scoping Process Results | F-2 |
| F.3 Comment Disposition and Issue Identification | F-3 |
| F.4 References | F-13 |

APPENDIX G

| | |
|---------------------------------------|------------|
| ENVIRONMENTAL JUSTICE ANALYSIS | G-1 |
| G.1 Introduction | G-1 |
| G.2 Definitions and Approach | G-1 |
| G.3 Methodology | G-2 |
| G.3.1 Spatial Resolution | G-2 |
| G.3.2 Population Projections | G-3 |
| G.4 Environmental Justice Assessment | G-4 |
| G.5 Results for the Sites | G-4 |
| G.5.1 Watts Bar Site | G-4 |
| G.5.2 Sequoyah Site | G-4 |
| G.5.3 Bellefonte Site | G-4 |
| G.6 Results for Transportation Routes | G-14 |
| G.7 Other Environmental Impacts | G-14 |
| G.8 Cumulative Impacts | G-15 |
| G.9 References | G-17 |

APPENDIX H

| | |
|--|------------|
| CONTRACTOR DISCLOSURE STATEMENT | H-1 |
|--|------------|

LIST OF FIGURES

| | | |
|-------------|--|------|
| Figure 1–1 | Schematic of Process for Producing Tritium in CLWRs | 1-3 |
| Figure 1–2 | Locations of Candidate CLWRs for Tritium Production | 1-5 |
| Figure 1–3 | Nuclear Weapons Stockpile Memorandum and Plan Process | 1-7 |
| Figure 1–4 | Diagram of a Modern Nuclear Weapon | 1-8 |
| | | |
| Figure 2–1 | Estimated Tritium Inventory and Reserve Requirements | 2-2 |
| | | |
| Figure 3–1 | Typical Pressurized Water Reactor Schematic | 3-3 |
| Figure 3–2 | Typical Fuel Assembly Cross-Sections | 3-4 |
| Figure 3–3 | Typical TPBAR Assembly | 3-5 |
| Figure 3–4 | Sketch of TPBAR Components | 3-6 |
| Figure 3–5 | Watts Bar Nuclear Plant | 3-14 |
| Figure 3–6 | Sequoyah Nuclear Plant | 3-18 |
| Figure 3–7 | Bellefonte Nuclear Plant | 3-21 |
| | | |
| Figure 4–1 | Location of the Watts Bar Nuclear Plant Site | 4-4 |
| Figure 4–2 | Watts Bar Nuclear Plant Site | 4-5 |
| Figure 4–3 | National Wetlands Inventory Map of Watts Bar Nuclear Plant Site Vicinity | 4-16 |
| Figure 4–4 | Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of Watts Bar 1 Projected for the Year 2025 | 4-22 |
| Figure 4–5 | Low-Income Households Residing Within 80 Kilometers (50 Miles) of Watts Bar 1 (1990) | 4-22 |
| Figure 4–6 | Transportation Routes in the Vicinity of the Watts Bar Nuclear Plant Site | 4-25 |
| Figure 4–7 | Location of the Sequoyah Nuclear Plant Site | 4-32 |
| Figure 4–8 | Sequoyah Nuclear Plant Site | 4-33 |
| Figure 4–9 | Wetlands Map of the Sequoyah Nuclear Plant Site Vicinity | 4-43 |
| Figure 4–10 | Racial and Ethnic Composition of the Minority Population Residing in Counties Within 80 Kilometers (50 Miles) of the Sequoyah Nuclear Plant Projected for the Year 2025 | 4-49 |
| Figure 4–11 | Low-Income Households Residing Within 80 Kilometers (50 Miles) of the Sequoyah Nuclear Plant (1990) | 4-49 |
| Figure 4–12 | Transportation Routes in the Vicinity of the Sequoyah Nuclear Plant Site | 4-51 |
| Figure 4–13 | Location of the Bellefonte Nuclear Plant Site | 4-59 |
| Figure 4–14 | Bellefonte Nuclear Plant Site | 4-60 |
| Figure 4–15 | Wetlands Map of the Bellefonte Nuclear Plant Site Vicinity | 4-70 |
| Figure 4–16 | Racial and Ethnic Composition of the Minority Population Residing in Counties Within 80 Kilometers (50 Miles) of the Bellefonte Nuclear Plant Projected for the Year 2025 | 4-80 |
| Figure 4–17 | Low-Income Households Residing Within 80 Kilometers (50 Miles) of the Bellefonte Nuclear Plant (1990) | 4-80 |
| Figure 4–18 | Transportation Routes in the Vicinity of the Bellefonte Nuclear Plant Site | 4-85 |
| Figure 4–19 | Jackson County Tax Revenue Distributions by Recipient FY 1997 | 4-86 |
| | | |
| Figure 5–1 | Staffing for Completion and Operation of Bellefonte 1, Compared to No Action from First Year of Construction | 5-58 |
| Figure 5–2 | Scottsboro School Board Projected Budget, Completion of Bellefonte 1 Versus the No Action Alternative (FY 1999-2002) | 5-62 |
| Figure 5–3 | Jackson County School Board Projected Budget, Completion of Bellefonte 1 Versus the No Action Alternative (FY 1999-2002) | 5-62 |

| | | |
|-------------|--|------|
| Figure 5-4 | Staffing for Completion and Operation of Bellefonte 1 and 2, Compared to No Action from First Year of Construction | 5-64 |
| Figure A-1 | Fission of Uranium-235 Atom | A-3 |
| Figure A-2 | Critical Chain Reaction | A-3 |
| Figure A-3 | Boiling Water Reactor Schematic | A-6 |
| Figure A-4 | Pressurized Water Reactor Schematic | A-6 |
| Figure A-5 | Representative Four-Loop Reactor Coolant System | A-7 |
| Figure A-6 | Typical 17 × 17 Reactor Fuel Assembly | A-9 |
| Figure A-7 | Representative Reactor Control Element Assembly | A-10 |
| Figure A-8 | General Arrangement of a Possible Reactor Core Fuel Loading Pattern | A-11 |
| Figure A-9 | Typical Fuel Transfer System | A-13 |
| Figure A-10 | TPBAR Transverse Cross Section | A-19 |
| Figure A-11 | TPBAR Longitudinal Cross Section | A-20 |
| Figure A-12 | TPBAR Hold-Down Assembly | A-21 |
| Figure E-1 | Typical Type B Legal Weight Track Shipping Cask | E-5 |
| Figure E-2 | Typical Type B Rail Shipping Cask | E-6 |
| Figure E-3 | Standards for Transportation Casks | E-8 |
| Figure E-4 | Overland Transportation Risk Assessment | E-11 |
| Figure E-5 | Representative Overland Truck Routes | E-14 |
| Figure E-6 | Conditional Probability Matrix for Modal Study Truck Cask | E-20 |
| Figure E-7 | Conditional Probability Matrix for Modal Study Rail Cask | E-20 |
| Figure E-8 | Conditional Probability Matrix for Truck Cask Transported by Rail | E-21 |
| Figure E-9 | Accident Matrix for Truck and Rail Casks Using Elastomeric Seals | E-24 |
| Figure E-10 | Accident Matrix for Truck and Rail Casks Using Metallic Seals | E-24 |
| Figure F-1 | NEPA Process | F-1 |
| Figure F-2 | Public Scoping Meeting Locations and Dates (1998) | F-2 |
| Figure G-1 | Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the Watts Bar Site | G-5 |
| Figure G-2 | Minority Population Residing Within 80 Kilometers (50 Miles) of the Watts Bar Site | G-6 |
| Figure G-3 | Minority Population Residing Within 16 Kilometers (10 Miles) of the Watts Bar Site | G-6 |
| Figure G-4 | Low-Income Populations Residing Within 80 Kilometers (50 Miles) of the Watts Bar Site | G-7 |
| Figure G-5 | Low-Income Population Residing Within 16 Kilometers (10 Miles) of the Watts Bar Site | G-7 |
| Figure G-6 | Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the Sequoyah Site | G-8 |
| Figure G-7 | Minority Population Residing Within 80 Kilometers (50 Miles) of the Sequoyah Site | G-9 |
| Figure G-8 | Minority Population Residing Within 16 Kilometers (10 Miles) of the Sequoyah Site | G-9 |
| Figure G-9 | Low-Income Population Residing Within 80 Kilometers (50 Miles) of the Sequoyah Site | G-10 |
| Figure G-10 | Low-Income Population Residing Within 16 Kilometers (10 Miles) of the Sequoyah Site | G-11 |
| Figure G-11 | Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the Bellefonte Site | G-11 |
| Figure G-12 | Minority Population Residing Within 80 Kilometers (50 Miles) of the Bellefonte Site | G-12 |
| Figure G-13 | Minority Population Residing Within 16 Kilometers (10 Miles) of the Bellefonte Site | G-13 |
| Figure G-14 | Low-Income Population Residing Within 80 Kilometers (50 Miles) of the Bellefonte Site | G-13 |
| Figure G-15 | Low-Income Population Residing Within 16 Kilometers (10 Miles) of the Bellefonte Site | G-14 |

LIST OF TABLES

| | <i>Page</i> |
|--|-------------|
| Table 3-1 Comparison of TPBAR with Typical Burnable Absorber Rod Characteristics | 3-6 |
| Table 3-2 CLWR Tritium Production Program Reasonable Alternatives | 3-12 |
| Table 3-3 General Design Specifications of Watts Bar Nuclear Plant Unit 1 | 3-13 |
| Table 3-4 Annual Liquid Releases to the Environment from Operation of Watts Bar 1 | 3-15 |
| Table 3-5 Summary of Annual Watts Bar 1 Gaseous Emissions | 3-16 |
| Table 3-6 Summary of Annual Watts Bar 1 Waste and Spent Fuel Generation Rates | 3-16 |
| Table 3-7 General Design Specifications of Sequoyah 1 or Sequoyah 2 | 3-17 |
| Table 3-8 Annual Liquid Releases to the Environment from Operating Sequoyah 1 or Sequoyah 2 | 3-19 |
| Table 3-9 Summary of Annual Sequoyah 1 or Sequoyah 2 Gaseous Emissions | 3-20 |
| Table 3-10 Summary of Annual Sequoyah 1 or Sequoyah 2 Waste and Spent Fuel Generation Rates | 3-20 |
| Table 3-11 Summary of Resources Required to Complete Construction of Bellefonte 1 or Bellefonte 1 and 2 | 3-24 |
| Table 3-12 General Design Specifications of Bellefonte 1 or Bellefonte 2 | 3-24 |
| Table 3-13 Summary of Environmental Consequences for the CLWR Reactor Alternatives | 3-31 |
| Table 3-14 Summary Comparison of Environmental Impacts Between CLWR Reactor Alternatives and the APT | 3-40 |
| | |
| Table 4-1 Comparison of Baseline Watts Bar 1 Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines | 4-7 |
| Table 4-2 Annual Radioactive Gaseous Emissions at Watts Bar 1 | 4-9 |
| Table 4-3 Summary of Surface Water Quality Monitoring in the Vicinity of the Watts Bar Site | 4-12 |
| Table 4-4 Annual Chemical and Radioactive Liquid Effluents Released to the Environment from Operation of Watts Bar 1 | 4-13 |
| Table 4-5 Listed Threatened or Endangered Species Potentially On or Near the Watts Bar Site | 4-18 |
| Table 4-6 General Demographic Characteristics of Spring City, Rhea County, and the Watts Bar 1 Region of Influence 1990 | 4-20 |
| Table 4-7 Population Distribution by Ethnic Group in Spring City, Rhea County, and the Watts Bar 1 Region of Influence (1990 U.S. Census) | 4-21 |
| Table 4-8 Income Data Summary for Spring City and Rhea County (1989) | 4-23 |
| Table 4-9 Sources of Background Radiation Exposure to Individuals in the Vicinity of the Watts Bar Site | 4-24 |
| Table 4-10 Annual Doses to the General Public During 1997 From Normal Operation at Watts Bar 1, (Total Effective Dose Equivalent) | 4-26 |
| Table 4-11 Annual Worker Doses from Normal Operation of Watts Bar 1 During 1997 | 4-26 |
| Table 4-12 Annual Waste Generation at Watts Bar 1 | 4-28 |
| Table 4-13 Comparison of Baseline Sequoyah 1 and 2 Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines | 4-35 |
| Table 4-14 Annual Radioactive Gaseous Emissions from Sequoyah 1 or Sequoyah 2 | 4-37 |
| Table 4-15 Summary of Surface Water Quality Monitoring in the Vicinity of the Sequoyah Nuclear Plant Site | 4-39 |
| Table 4-16 Annual Chemical and Radioactive Liquid Effluents from Operation of Sequoyah 1 or Sequoyah 2 | 4-40 |
| Table 4-17 Listed Threatened or Endangered Species Potentially On or Near the Sequoyah Nuclear Plant Site | 4-45 |
| Table 4-18 General Demographic Characteristics of Soddy Daisy, Hamilton County, and the Sequoyah Region of Influence (1990 U.S. Census) | 4-47 |
| Table 4-19 Population Distribution by Ethnic Group in Soddy Daisy, Hamilton County, and the Sequoyah Region of Influence (1990 U.S. Census) | 4-48 |
| Table 4-20 Income Data Summary for Soddy Daisy and Hamilton County (1989) | 4-50 |
| Table 4-21 Sources of Background Radiation Exposure to Individuals in the Vicinity of the Sequoyah Nuclear Plant Site | 4-52 |

| | | |
|------------|--|------|
| Table 4–22 | Annual Doses to the General Public During 1997 from Normal Operation at Sequoyah 1 or Sequoyah 2 (Total Effective Dose Equivalent) | 4-53 |
| Table 4–23 | Annual Worker Doses from Normal Operation at Sequoyah 1 or Sequoyah 2 During 1996 | 4-53 |
| Table 4–24 | Annual Waste Generation at Sequoyah 1 and 2 | 4-55 |
| Table 4–25 | Comparison of Baseline Bellefonte 1 and 2 Ambient Air Concentrations With the Most Stringent Applicable Regulations and Guidelines | 4-63 |
| Table 4–26 | Summary of Surface Water Quality Monitoring in the Vicinity of the Bellefonte Nuclear Plant Site | 4-65 |
| Table 4–27 | Public and Industrial Surface Water Supplies From the Tennessee River Near Bellefonte | 4-66 |
| Table 4–28 | Federally and State-Listed Threatened or Endangered Species On or Near the Bellefonte Nuclear Plant Site | 4-74 |
| Table 4–29 | Unemployment Percentages in Jackson County (1991–1997) | 4-76 |
| Table 4–30 | Per Capita and Household Income in the City of Scottsboro and Jackson County (Estimates for 1997) | 4-77 |
| Table 4–31 | Industrial Occupation Distribution for Jackson County, Alabama, and the United States (1996 Main Occupations as a Percentage of Total Employment Only) | 4-77 |
| Table 4–32 | General Demographic Characteristics of the Bellefonte Nuclear Plant Site Region of Influence and Jackson County (1990 Census) | 4-78 |
| Table 4–33 | Population Distribution by Race and Hispanic Origin in Jackson County, the Bellefonte Nuclear Plant Site Region of Influence, and the United States | 4-79 |
| Table 4–34 | Scottsboro School System Breakdown by Academic Year (1991–1998) | 4-82 |
| Table 4–35 | Fire Protection Services Available in the City of Scottsboro, Jackson County, and the Bellefonte Nuclear Plant Site Region of Influence (April 1998) | 4-84 |
| Table 4–36 | Jackson County Revenue Distributions by Recipient (Selected Recipients Only) and Tax and Fee Revenue Sources, Fiscal Year 1997 (October 1996 Through September 1997) | 4-87 |
| Table 4–37 | Sources of Radiation Exposure to Individuals in the Vicinity of the Bellefonte Nuclear Plant Site | 4-88 |
| Table 5–1 | Annual Radioactive Gaseous Emissions at Watts Bar 1 | 5-5 |
| Table 5–2 | Annual Radioactive Liquid Effluents at Watts Bar 1 | 5-6 |
| Table 5–3 | Tritium Concentration in the Tennessee River from Tritium Production at Watts Bar 1 | 5-6 |
| Table 5–4 | Annual Radiological Impacts to the Public from Incident-Free Tritium Production Operations at Watts Bar 1 | 5-10 |
| Table 5–5 | Annual Radiological Impacts to Workers from Incident-Free Tritium Production Operations at Watts Bar 1 | 5-10 |
| Table 5–6 | Radiological Impacts to the Public from the Failure of 2 TPBARs at Watts Bar 1 | 5-11 |
| Table 5–7 | Radiological Impacts to Workers from the Failure of 2 TPBARs at Watts Bar 1 | 5-11 |
| Table 5–8 | Design-Basis Accident Consequence Margin to Site Dose Criteria at Watts Bar 1 | 5-12 |
| Table 5–9 | Annual Accident Risks at Watts Bar 1 | 5-13 |
| Table 5–10 | Accident Frequencies and Consequences at Watts Bar 1 | 5-14 |
| Table 5–11 | Annual Radioactive Gaseous Emissions at Sequoyah 1 or Sequoyah 2 | 5-18 |
| Table 5–12 | Annual Radioactive Liquid Effluent at Sequoyah 1 or Sequoyah 2 | 5-20 |
| Table 5–13 | Tritium Concentration in the Tennessee River from Tritium Production at Sequoyah 1 or Sequoyah 2 | 5-20 |
| Table 5–14 | Annual Radiological Impacts to the Public from Incident-Free Tritium Production Operations at Sequoyah 1 or Sequoyah 2 | 5-23 |
| Table 5–15 | Annual Radiological Impacts to Workers from Incident-Free Tritium Production Operations at Sequoyah 1 or Sequoyah 2 | 5-24 |
| Table 5–16 | Radiological Impacts to the Public from the Failure of 2 TPBARs at Sequoyah 1 or 2 | 5-25 |
| Table 5–17 | Radiological Impacts to Workers from the Failure of 2 TPBARs at Sequoyah 1 or Sequoyah 2 | 5-25 |
| Table 5–18 | Design-Basis Accident Consequence Margin to Site Dose Criteria at Sequoyah 1 or Sequoyah 2 | 5-26 |
| Table 5–19 | Annual Accident Risks at Sequoyah 1 or Sequoyah 2 | 5-27 |
| Table 5–20 | Accident Frequencies and Consequences at Sequoyah 1 or Sequoyah 2 | 5-28 |
| Table 5–21 | General Construction Equipment Noise Levels | 5-34 |

| | | |
|------------|---|-------|
| Table 5–22 | Annual Nonradioactive Gaseous Emissions from Bellefonte 1 or Both Bellefonte 1 and 2 During Construction | 5-37 |
| Table 5–23 | Annual Air Pollutant Concentrations from Bellefonte 1 and 2 During Construction | 5-38 |
| Table 5–24 | Nonradioactive Gaseous Emissions from Bellefonte 1 and 2 During Operations | 5-39 |
| Table 5–25 | Annual Air Pollutant Concentrations from Bellefonte 1 and 2 During Operations | 5-40 |
| Table 5–26 | Annual Radioactive Gaseous Emissions from Tritium Production at Bellefonte 1 | 5-42 |
| Table 5–27 | Potential Changes to Water Resources from Bellefonte 1 or Bellefonte 1 and 2 | 5-45 |
| Table 5–28 | Summary of “Added” Inorganic Chemical Discharges to Guntersville Reservoir from Operation of Bellefonte 1 and Bellefonte 1 and 2 | 5-46 |
| Table 5–29 | Summary of Observed Trace Metal Concentrations and Expected Trace Metal Concentrations in the Discharge Stream and at the Edge of the Mixing Zone from Operation of Bellefonte 1 and Bellefonte 1 and 2 | 5-47 |
| Table 5–30 | Annual Radioactive Liquid Effluents from Tritium Production at Bellefonte 1 | 5-50 |
| Table 5–31 | Tritium Concentration in the Tennessee River from Tritium Production at Bellefonte 1 or Bellefonte 2 | 5-50 |
| Table 5–32 | Staffing for Completion and Operation of Bellefonte 1 | 5-58 |
| Table 5–33 | Staffing For Completion And Operation of Bellefonte 1 and 2 | 5-64 |
| Table 5–34 | Annual Radiological Impacts from Incident-Free Tritium Production Operations at Bellefonte 1 | 5-70 |
| Table 5–35 | Annual Radiological Impacts to Workers from Incident-Free Tritium Production Operations at Bellefonte 1 | 5-71 |
| Table 5–36 | Radiological Impacts to the Public from the Failure of 2 TPBARs at Bellefonte 1 | 5-72 |
| Table 5–37 | Radiological Impacts to Workers from the Failure of 2 TPBARs at Bellefonte 1 | 5-72 |
| Table 5–38 | Cancer and Noncancer Adverse Health Impacts from Exposure to Hazardous Chemicals at Bellefonte 1 and 2 During Construction | 5-73 |
| Table 5–39 | Cancer and Noncancer Adverse Health Impacts from Exposure to Hazardous Chemicals at Bellefonte 1 and 2 During Normal Operation | 5-74 |
| Table 5–40 | Design-Basis Accident Consequence Margin to Site Dose Criteria at Bellefonte 1 | 5-77 |
| Table 5–41 | Annual Accident Risks at Bellefonte 1 | 5-78 |
| Table 5–42 | Accident Frequencies and Consequences at Bellefonte 1 | 5-79 |
| Table 5–43 | Emergency Response Planning Guideline Values for Hydrazine and Ammonia | 5-81 |
| Table 5–44 | Summary of Impacts Data for Release Scenarios at Bellefonte 1 | 5-81 |
| Table 5–45 | Total Amounts of Wastes Generated During Construction to Complete Bellefonte 1 or Both Bellefonte 1 and 2 | 5-83 |
| Table 5–46 | Annual Waste Generation at Bellefonte 1 | 5-84 |
| Table 5–47 | Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants | 5-88 |
| Table 5–48 | Data for Number of ISFSI Cask Determination for Each Nuclear Power Plant | 5-94 |
| Table 5–49 | Environmental Impact of ISFSI Construction | 5-95 |
| Table 5–50 | Environmental Impact of ISFSI Operation | 5-98 |
| Table 5–51 | Environmental Impact of Accidents at ISFSI | 5-101 |
| Table 5–52 | Materials Required for TPBAR Production | 5-104 |
| Table 5–53 | Additional Fuel Requirements | 5-105 |
| Table 5–54 | Risks of Transporting the Hazardous Materials | 5-106 |
| Table 5–55 | Sensitivity Analysis Key Parameters | 5-109 |
| Table 5–56 | Sensitivity Analysis Summary for a Single Reactor Site | 5-110 |
| Table 5–57 | Estimated Accelerator Production of Tritium Carbon Dioxide Emissions | 5-116 |
| Table 5–58 | Accident Impacts on Involved Workers | 5-117 |
| Table 5–59 | Cumulative Impacts at the Watts Bar Nuclear Plant Site | 5-119 |
| Table 5–60 | Cumulative Impacts at the Sequoyah Nuclear Plant Site | 5-120 |
| Table 5–61 | Announced Major Recent and Future Expansions and New Industrial Facilities for Jackson County (1997 and 1998) | 5-121 |
| Table 5–62 | Cumulative Impacts at the Bellefonte Nuclear Plant Site | 5-122 |
| Table 5–63 | Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2035) | 5-124 |
| Table 5–64 | Summary of Environmental Impacts, Tritium Extraction Facility | 5-124 |
| Table 5–65 | Resources Consumed During Construction–Bellefonte 1 and 2 | 5-130 |

| | | |
|------------|--|------|
| Table 6–1 | Systematic Assessments of Licensee Performance Results for the Watts Bar Nuclear Power Plant | 6-12 |
| Table 6–2 | Systematic Assessments of Licensee Performance Results for the Sequoyah Nuclear Power Plant | 6-15 |
| Table A–1 | Summary of Increase in Spent Fuel Generation From 40 Years of Tritium Production with Maximum Number of TPBARs | A-23 |
| Table B–1 | Federal Environmental Statutes, Regulations, and Executive Orders | B-9 |
| Table B–2 | Relevant DOE Orders and NRC Guides | B-13 |
| Table C–1 | Exposure Limits for Members of the Public and Radiation Workers | C-7 |
| Table C–2 | Nominal Health Effects Coefficients (Risk Factors) from Ionizing Radiation | C-8 |
| Table C–3 | GENII Exposure Parameters to Plumes and Soil Contamination (Normal Operations) | C-16 |
| Table C–4 | GENII Usage Parameters for Consumption of Terrestrial Food | C-17 |
| Table C–5 | GENII Usage Parameters for Consumption of Animal Products | C-17 |
| Table C–6 | GENII Liquid Pathway Parameters | C-18 |
| Table C–7 | Annual Increase in Tritium Releases to the Environment at Each Site | C-19 |
| Table C–8 | Increases in Tritium Releases to the Environment from Two Failed TPBARs in an 18-Month Operating Cycle | C-20 |
| Table C–9 | Average (1996-1997) Annual Radioactivity Releases to the Air and Liquid at Watts Bar 1 | C-20 |
| Table C–10 | Average (1995-1997) Annual Radioactivity Releases to the Air and Liquid at Sequoyah 1 or Sequoyah 2 | C-21 |
| Table C–11 | Annual Radiological Impacts to the Public from Incident-Free Tritium Production Operations at Watts Bar 1 | C-24 |
| Table C–12 | Annual Radiological Impacts to the Public from Incident-Free Tritium Production Operations at Sequoyah 1 or Sequoyah 2 | C-24 |
| Table C–13 | Annual Radiological Impacts to the Public from Incident-Free Tritium Production Operations at Bellefonte 1 | C-25 |
| Table D–1 | Reactor Design-Basis Accident Tritium Inventory | D-3 |
| Table D–2 | Reactor Design-Basis Accident Tritium Source Term Released to Environment | D-3 |
| Table D–3 | Reactor Design-Basis Accident Frequency Estimates for Large Break Loss-of-Coolant Accident | D-3 |
| Table D–4 | Nonreactor Design-Basis Accident Tritium Source Term | D-4 |
| Table D–5 | TPBAR Handling Accident Frequency Estimates | D-5 |
| Table D–6 | Truck Transportation Cask Handling Accident Frequency Estimates | D-6 |
| Table D–7 | Rail Transportation Cask Handling Accident Frequency Estimates | D-7 |
| Table D–8 | Definition and Causes of Containment Failure Mode Classes | D-10 |
| Table D–9 | Watts Bar 1 and Sequoyah 1 and 2 Core Inventory | D-11 |
| Table D–10 | Release Category Timing and Source Terms | D-12 |
| Table D–11 | Release Category Frequencies and Related Accident Sequences for the Watts Bar and Sequoyah Nuclear Plants | D-12 |
| Table D–12 | Bellefonte Nuclear Plant Reactor Core Inventory | D-14 |
| Table D–13 | Release Category Timing and Source Term | D-15 |
| Table D–14 | Release Category Frequencies and the Related Accident Sequences for the Bellefonte Nuclear Plant | D-15 |
| Table D–15 | NUREG/CR-4551 Protection Factors | D-19 |
| Table D–16 | GENII-Generated Reactor Design-Basis Accident Consequences | D-27 |
| Table D–17 | Reactor Design-Basis Accident Annual Risks | D-27 |
| Table D–18 | Reactor Design-Basis Accident Consequences Using the NRC Analysis Approach | D-27 |
| Table D–19 | Reactor Design-Basis Accident Consequence Margin to Site Dose Criteria | D-28 |
| Table D–20 | GENII-Generated Nonreactor Design-Basis Accident Consequences | D-29 |

| | | |
|------------|---|------|
| Table D–21 | Nonreactor Design-Basis Accident Annual Risks | D-29 |
| Table D–22 | Nonreactor Design-Basis Accident Consequences Using the NRC Analysis Approach | D-30 |
| Table D–23 | Nonreactor Design-Basis Accident Consequence Margin to Site Dose Criteria | D-30 |
| Table D–24 | TPBAR Handling Accident Consequences | D-33 |
| Table D–25 | TPBAR Handling Accident Annual Risks | D-33 |
| Table D–26 | Truck Transportation Cask Handling Accident Consequences | D-33 |
| Table D–27 | Truck Transportation Cask Handling Accident Annual Risks | D-33 |
| Table D–28 | Rail Transportation Cask Handling Accident Consequences | D-34 |
| Table D–29 | Rail Transportation Cask Handling Accident Annual Risks | D-34 |
| Table D–30 | Beyond Design-Basis Accident Consequences | D-35 |
| Table D–31 | Beyond Design-Basis Accident Annual Risks | D-36 |
| Table D–32 | Chemical Inventory at the Bellefonte Nuclear Plant Site | D-37 |
| Table D–33 | Emergency Response Planning Guide Values for Hydrazine and Ammonia | D-39 |
| Table D–34 | Airborne Concentration Estimates for Ammonium Hydroxide (NH ₃) Release Scenarios | D-42 |
| Table D–35 | Airborne Concentration Estimates for Hydrazine Release Scenarios | D-42 |
| Table D–36 | Summary of Impacts Data for Release Scenarios | D-42 |
| | | |
| Table E–1 | Potential Shipping Routes Evaluated for the CLWR EIS | E-15 |
| Table E–2 | Irradiated Hardware and TPBAR Inventory | E-17 |
| Table E–3 | Release Fractions for Truck and Rail Casks with No Prefailed TPBARs | E-25 |
| Table E–4 | Release Fractions for Truck Casks with Two Prefailed TPBARs | E-25 |
| Table E–5 | Release Fractions for Rail Casks with Two Prefailed TPBARs | E-26 |
| Table E–6 | Accident Category Severity Fractions | E-26 |
| Table E–7 | Radiological Risk Factors for Single Shipments | E-28 |
| Table E–8 | Nonradiological Risk Factors per Shipment | E-30 |
| Table E–9 | Risks of Transporting the Hazardous Materials | E-31 |
| Table E–10 | Estimated Dose to Exposed Individuals During Incident-Free Transportation Conditions | E-32 |
| Table E–11 | Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2035) | E-33 |
| | | |
| Table F–1 | Issues Already Included in the EIS (In Scope) | F-4 |
| Table F–2 | Issues Added to the Scope of the EIS | F-5 |
| Table F–3 | Issues Considered to be Out of Scope or Raised But Not Analyzed | F-5 |
| | | |
| Table G–1 | Minority Populations Residing Near Highway Routes from Potential Sites to the Savannah River Site | G-16 |
| Table G–2 | Racial and Ethnic Composition of Minority Populations (2025) Residing Within 1.6 Kilometers (1 Mile) Along Highway from Potential Sites to the Savannah River Site | G-16 |
| Table G–3 | Low-Income Populations Residing Near Highway Routes from Potential Sites to the Savannah River Site | G-16 |

ACRONYMS AND ABBREVIATIONS

| | |
|--------------|---|
| APT | Accelerator Production of Tritium |
| BEIR | Biological Effects of Ionizing Radiation |
| Bellefonte 1 | Bellefonte Nuclear Plant Unit 1 |
| Bellefonte 2 | Bellefonte Nuclear Plant Unit 2 |
| CFR | Code of Federal Regulations |
| CLWR | Commercial light water reactor |
| DOE | U.S. Department of Energy |
| EIS | Environmental impact statement |
| EPA | U.S. Environmental Protection Agency |
| FR | Federal Register |
| HEPA | High-efficiency particulate air |
| IAEA | International Atomic Energy Agency |
| ISFSI | Independent spent fuel storage installation |
| NEPA | National Environmental Policy Act |
| NPDES | National Pollutant Discharge Elimination System |
| NRC | U.S. Nuclear Regulatory Commission |
| OSHA | Occupational Safety and Health Administration |
| P.L. | Public Law |
| Sequoyah 1 | Sequoyah Nuclear Plant Unit 1 |
| Sequoyah 2 | Sequoyah Nuclear Plant Unit 2 |
| START | Strategic Arms Reduction Treaty |
| TPBAR | Tritium-producing burnable absorber rod |
| TVA | Tennessee Valley Authority |
| U.S.C. | United States Code |
| Watts Bar 1 | Watts Bar Nuclear Plant Unit 1 |
| Watts Bar 2 | Watts Bar Nuclear Plant Unit 2 |